California Division of Mines and Geology

Fault Evaluation Report FER-6

August 25, 1976

1. Name of fault: Mesa fault.

2. Location of fault: Santa Barbara 7.5 minute quadrangle, City of Santa Barbara, Santa Barbara County (see index map, figure 1).

3. Reason for evaluation: The Mesa fault lies in an area currently being studied as part of a ten-year program to determine which faults in the state are active.

4. List of references:

a) Dibblee, T.W. Jr., 1966, Geology of the central Santa Ynez Mountains, Santa Barbara County, California: California Division of Mines and Geology, Bulletin 186, 99 p.

b) Herron, R.F., 1975, Geologic hazards map prepared for the City of Santa Barbara (copy on file in A-P room).

c) Jennings, C.W., 1975, Fault map of California: California Division of Mines and Geology, Geologic data map series, Map no. 1.

d) Lee, W.H.K., and Vedder, J.G., 1973, Recent earthquake activity in the Santa Barbara Channel region, Bulletin Seismological Society of America, v. 63, no. 5, p. 1757-1773.

e) Moore and Taber, 1974, Santa Barbara County comprehensive plan -- Seismic Safety Element, 93 p.

f) Muir, K.S., 1968, Groundwater reconnaissance of the Santa Barbara-Montecito area, Santa Barbara County, California: U.S. Geological Survey Water Supply Paper 1859-A, 28 p.

g) Nason, R., Personal communication of April 1, 1976.

h) Sylvester, A.G., Personal communication of March 24, 1976.

i) Upson, J.E., 1951, Geology and groundwater resources of the south-coast basins of Santa Barbara County, California: U.S. Geological Survey Water Supply Paper 1108, 144 p.

j) Willis, B., 1925, Fault map of the Santa Barbara district, California: Bulletin of the Seismological Society of America, v. 15, 1 plate.

k) Willott, J.A., 1972, Analysis of modern vertical deformation in the western Transverse Ranges, California: M.A. thesis, University of California at Santa Barbara, 81 p.

l) Ziony, J.I., et al., 1974, Preliminary map showing recency of faulting in southern California: U.S. Geological Survey, Miscellaneous Field Studies Map, MF-585.

m) NASA, U-2 aerial photographs, False-color IR, flight number 73-194, roll 01541, frames 6519 to 6521.

5. Summary of available data:

a. Location -- Dibblee (1966), Muir (1968), and Upson (1951) all have their own versions of the location of the Mesa fault (see figure 3). Muir and Upson both base their mapping on ground water barriers that exist at depth and have been projected to the surface. Neither Muir nor Upson has any evidence of surface features associated with the fault. Dibblee does show a 1500' long section in the central portion of the fault which he shows as inferred. He bases this on the escarpment at the north edge of "The Mesa" (see figure 2, locality 1). Dibblee, Muir, and Upson all portray the fault as a high angle (near vertical) fault with SW side up. The total amount of slip is not known. Dibblee estimates the base of the upper Pliocene Santa Barbara Formation to be offset about 2000'. All workers show the fault to be approximately 5 miles long, extending from the coastline, through downtown Santa Barbara, until it merges(?) with the More Ranch fault to the NW.

b. Recency -- None of the references listed above show the fault offsetting any mapped Holocene unit. Dibblee does show the contact between Pleistocene fanglomerate and recent alluvium, at locality 1, to be inferred fault contact. As discussed above, this is based on geomorphic evidence. Elsewhere, the fault is shown as concealed beneath Holocene alluvium.

A first order leveling survey of benchmarks was done in 1960 and again in 1971 by the U.S. Coast and Geodetic Survey along the Southern Pacific rail line. This data indicated local elevation changes (down on the NW) along the surveyed rail line. Willott (1972) tried to relate one of these changes to activity along the Mesa fault. However, certain problems exist with Willott's interpretations. First, benchmarks Y-1042 and N-28 (figure 2) between which major elevation changes are said to occur, are located on the same side of the Mesa fault. Since the fault does not lie between these locations, the elevation change cannot be attributed to movement along the fault as mapped. Second, figure 10 of Willott's thesis shows the location and relative amounts of offset between benchmarks surveyed. The elevation change described by Willott at the end of the Santa Barbara survey line east of benchmark N-28 seems to rebound at the third station near Carpenteria. He does not explain the reason for this.

In summary, it appears that Willott's data do not apply to the Mesa fault as it is mapped by Dibblee and others. The suggested elevation changes could be related to: 1) survey errors; 2) tectonic movement on an unmapped fault; 3) improper mapping of the Mesa fault; 4) non-tectonic ground subsidence; 5) a combination of these factors.

Sylvester (1976) reports that he and students from UCSB have been monitoring several level lines across the Mesa fault since 1970 (see figure 2, lines a,b,c). Only line b has shown any activity. Sylvester reports 20 mm of progressive elevation change where the line crosses the fault as mapped by Dibblee. The direction of elevation change reported is NE side up. Sylvester has no explanation for this.

Sylvester also reports cracked and deformed curbs and sidewalks along the east segment of the fault. However, Nason (1976) stated that the evidence didn't point unequivocally to fault creep as the cause of the cracks.

Jennings (1975) classifies this fault as historically active. He bases this on the data of Willott and Sylvester.

Willis (1925) reported that the 1925 magnitude $6.5\pm$ earthquake was probably located on the Mesa fault. However, the accuracy pf epicenter plotting in 1925 was only good to about a 10 mile radius. Lee and Vedder (1973) state that any one of the recently active off-shore faults may have been the cause of the 1925 earthquake.

6. <u>Interpretation of air photos:</u>

The only photos interpreted are U-2, false color IR, at a scale of 1:125,000 (approximately 1" = 2 miles). Small topographic features along the mapped trace of the fault could not be seen, if they exist.

However, the high mesa located on the SW side of the fault was quite prominent. The NE edge of the mesa did not appear as a clearly defined linear scarp where mapped by Dibblee.

7. Field observations:

The surface location and recency of activity of the Mesa fault is largely obscured by man's development. Evidence reported by others at several localities (see figure 2) is discussed below:

Locality 1 -- The abrupt rise of "The Mesa" here led Dibblee to show the fault as inferred. A roadcut in massive Quaternary fanglomerate at 1a shows no evidence of faulting (i.e. gouge, shears, etc.).

Locality 2 -- Random cracks in the pavement and street surface and broken curbs were observed along Anapamu Street for 2 or 3 blocks. This area of the city is very old and the street owes its condition to its age. At the end of the leader at locality 2 a walkway leading to a house is pushed out perpendicularly over a low wall that parallels the street. A local resident in the area said that the push-out happened as a result of the owner driving his car off the front lawn onto the street.

Locality 3 -- An anomalous outcrop of Oligocene Sespe Formation outcrops here (see Dibblee, plate 1). Since this outcrop is located on the SW side of the fault it suggests SW side up. This conflicts with the level line data of Willott and Sylvester.

Locality 4 -- Cracks exist on Castillo Ave. from 4a to 4c. At 4a a curb has been pushed up and out northward, presumably due to compression. At 4b near the bottom of the underpass at least 3 cracks have opened up extending all the way across the street from curb to curb.

The curbs have pulled apart up to 1" and the downslope side has dropped presumably due to tension. Water is seeping from the walls of the underpass in at least 2 places between 4b and 4c. This could be related to a spring located on the groundwater barrier formed by the fault. These anomalies are all located on the fault trace of Dibblee.

Locality 5 -- Cracks exist on Yanonali Avenue between 5a and 5b. Most of the cracks are in the curbs and sidewalks. They show no systematic offset, and seem to increase in number near the many large trees on this street. Some of the cracks are push-outs; others nearer the trees are pull-aparts. No connection was observed between cracks on opposite sides of the street. Also, there are so many cracks widely distributed and randomly oriented that they can't be related faulting. More than likely the tree roots are the cause.

Locality 6 -- An old Southern Pacific rail line (no longer present) reportedly was offset at locality 6 during the 1925 earthquake (Sylvester). Since then, development in the area has obscured any evidence of faulting. The rail line, however, could have been offset by secondary failure of the underlying alluvial materials during the earthquake.

8. Conclusions:

The evidence for historic activity of even Holocene activity along the Mesa fault is inconclusive at best. In fact, some of it is contradictory. Leveling data contradicts the geology of Dibblee. The "creep" features are not conclusive, but may be due to other causes. Dibblee has no unequivocally faulted Holocene unit mapped. Therefore, this fault is not considered to be "sufficiently active" at this time.

The fault apparently is not "well-defined." There are at least three different interpretations of the location of the fault (Dibblee, Muir, Upson).

9. Recommendations:

The existing evidence for recent faulting is inconclusive and contradictory. Therefore, zoning the Mesa fault for Special Studies is not recommended at this time.

10. Investigating geologist's name; date:

Edward J Bortugno

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August 25, 1976

11. Reviewed by: Approved, Earl W. Hart, 9/2/76